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Building Maintenance Management Preliminary Finding of a Case Study in Icym

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Abstract: Building Maintenance Management (BMM) is essential to prolong the building life cycle and reduce the company loss. When buildings are neglected, defects can occur which may result in extensive and unavoidable damage to the building fabric or structure. The objective of this study is to identify International College of Yayasan Melaka (ICYM) building maintenance problems. As such, the chosen building needs to be identified before the research start. The defect and the problem face will be collected and noted in a check list. This will be done by questionnaires and distributed to all service users in ICYM building management office and student hostel. Interview sessions and site visit are also conducted to understand the problem encounter. Hence, this paper is focusing on the maintenance management system which the aim is to reduce the downtime of plant items taking into account the possible impact of a failure in terms of cost. The analysis shows that the hostel building contributed to the most problematic area in ICYM. Based on the preliminary finding, it shows that there is a need to propose a systematic building maintenance management.

Key words: Building Maintenance Management · Defect and Failure

INTRODUCTION

Maintenance is defined as a combination of technical and administrative actions contributing to the protection and satisfactory operation of asset maintenance includes everything from regular cleaning to repairs and replacements. It can be as small as changing a washer to stop a leaking tap, or as large as repainting an entire building. Good maintenance helps retain the value of the building and makes the property more enjoyable to occupy. Neglect of maintenance can also become a fire and safety hazard which could result in being legally liable for any injuries.

Types of Maintenance: Maintenance can be categorized according to why and when it happens and includes:-

- Corrective maintenance - to keep the building at an acceptable standard. This includes cleaning gutters and changing light bulbs. Corrective maintenance would normally be carried out by the occupant.
- Predictable (planned) maintenance - to prevent predictable failure of building infrastructure or capital items. This includes repainting surfaces or replacing roof cladding at the times specified by product manufacturers.
- Emergency corrective maintenance - must happen immediately for health and safety or security reasons. This includes work that may result in the rapid deterioration of the structure or fabric if unattended to immediately. Such includes roof repairs after cyclones, graffiti removal or repair of broken glass.

A repetitive process is needed in order to provide adequate maintenance. A maintenance plan will ensure the correct approach is carried out and any shortfalls are discovered and corrected in a timely manner. Maintenance includes the required processes and services carried out to preserve, repair, protect and care for the building's fabric and engineering services after completion, repair, refurbishment or replacement to current standards to enable it to serve its intended functions throughout its entire lifespan without drastically upsetting its basic features and use [1].

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The premise for this study is the move from the building and its management as the main focus for the maintenance management process towards the value chain (enhance productivity and user satisfaction) as the main focus. The value chain is the focus for more effective and efficient strategy of creating value to maintenance organization and building users. Value creation is increasingly viewed as a process of facilitating a network of relationships within which organizations are positioned [2, 3]. The deficiencies in the practices could be due to the way the policies are framed, how they are being understood or how they are enforced. Good maintenance management should be simple, dynamic and capable of periodic review as the need arises to accommodate technological advancements and the clients' and users' value systems [4]. When developing a maintenance management system, users (and client-occupiers) must be involved to ensure that their satisfaction is proactively taken into account while formulating the maintenance policy. In addition, the current proposals depend on the physical conditions of the building to establish the maintenance need and, therefore, are conditional based. Conditionally based maintenance is not a proactive maintenance policy. At best, all that a condition-based maintenance policy does is to provide a snapshot of the physical condition of the building at the specific time that the survey was conducted. Conditionally based maintenance policy is not explicitly linked to the ability of a building to support organization performance [2]. The physical condition of a building is just a symptom of defects, deterioration, or decay, or their combination. Under the current approaches to buildings maintenance, maintenance is not factored as a factor of production, which also leads to the fragmentation of the building management processes [3].

Problem Statement

There Is an Evident: that a part of maintenance records coming from complaint and demand from user. Several drawbacks are listed below:

- Maintenance schedule that not properly made for building maintenance.
- There is lack of study and prediction to overcome building maintenance.
- Unsystematic plan to reduce downtime of building items or reducing maintenance and inspection costs, taking into account the possible impact of a failure in terms of cost to the company.
- Improve study is conducted on subjective measure of the consequences of such a failure in terms of cost, in monetary value to the company and the damaging effect to the company.

Research Objectives: The main objectives of this research are as follows:

- To investigate the problem of building maintenance management in ICYM hostel.
- To analyze the number of breakdown, downtime and cost in ICYM hostel maintenance management.

Scope: University buildings are one of the factors to produce a quality student. The buildings are procured to create a suitable, conducive and adequate environment that supports, stimulates and encourages learning, teaching and innovations. A failure in the supply of these essential services is a loss in value to the university institution, the community, the students, staff and other stakeholders. Obviously by constructing new buildings is helping to upgrade educational facilities and provide better quality education; however, it is of utmost importance to maintain the existing buildings to meet an acceptable quality standards that are capable of facilitating the transfer of knowledge and carrying out other academic activities effectively and efficiently. This research is focusing on ICYM building especially on ICYM hostel.

Fig. 2.1: is a flowchart of the research design.

Research Design

Understand the Process: Before the development of any maintenance model, a thorough understanding of the processes involved is essential. Insufficient or inadequate work in this area will almost certainly spell disaster in the task of understanding the problems of a company. When understanding a process it is equally important to consider the tasks carried out at inspection as well as during maintenance. It may be the case that there are several parts that fails regularly might be overlooked because it is inexpensive to correct.

Identify the Problems: Several techniques using risk-based analysis can be useful in this phase of the study including event tree analysis (ETA) or failure mode and effects analysis (FMEA). Snapshot model [3, 5] is a kind of hierarchical analysis where all possible failures are classified into different levels and groups. ETA can be used to identify various possible outcomes, given an initiating event. An example of this is a component failing,

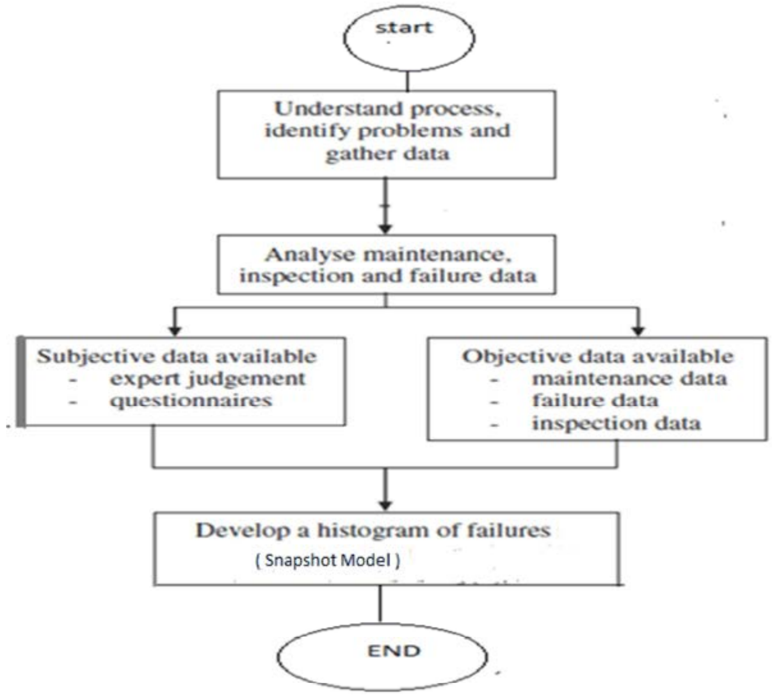

Fig. 2.1: Flowchart of the research design
(adopt from B.Jones, I.Jenkinson. and J.Wang 2007)

giving an indication to an area of equipment or process that requires further investigation. FMEA can identify possible failure modes and the effects on the system but can also give a potential severity to the effect, this being most useful when looking at environmental or safety critical items. Having spoken to maintenance managers, production managers and key shop floor staff, a thorough understanding of the process should now be possible. Problems such as lengthy breakdowns, especially in the case of high-volume equipment should all become apparent. Care should be taken as to whether a breakdown is a maintenance issue and not an engineering issue or operator issue. An example of an engineering issue may be working to an incorrect drawing or procedure, an operator issue may be performing of a task using incorrect tooling or running a machine at a higher rate than it was originally designed to run. Once the key plant items have been identified together with a list of dominant failures associated with the item, data can then be gathered.

Establish Required Data: Data can come in many forms from maintenance departments and more often than not be extremely detailed; however, for the purposes of producing a maintenance model, this information is often unusable The majority of data gathered by maintenance departments are generally the name of the equipment or the part number to have failed, the repairs made including spare parts used and the time the repair or inspection has taken to return the equipment to production. Therefore, the type of data collected is important along with some basic assumptions for the equipment or component investigated. The types of data required for a maintenance model are as follows:

- Average downtime due to inspection, *d*.
- Average downtime for a breakdown repair, *db.*
- Arrival rate of defects per unit time, *kf*.
- Inspection period, *T*.
- Failure rate l (1/MTBF).

Downtime due to inspection, d is the amount of time, on average, an inspection will take to complete and return the equipment to production. The average downtime due to a breakdown and subsequent repair of the equipment db is the time it takes on average to return the equipment to production. The units of both downtime inspection and breakdown repair downtime must be identical but can be measured in hours, days or months depending on the equipment under investigation. The arrival rate of a defect, *kf* is the average time a defect arises over a period of time, calculated by the number of defects divided by the total operating time of the equipment under investigation. The inspection period is simply the time interval between inspections. Failure rate l is the reciprocal of mean time between failures (MTBF), where MTBF is the mean operating time between failures of a component or piece of equipment. MTBF, however, should not be confused with the delay-time of a component or a piece of equipment. The delay-time is the time from an initial telltale sign of failure to actual failure, both being dependant on the inspection interval, T

Gather Data: The question as to whether a maintenance model is carried out using either subjective means or objective means is dependent on what data are available. If maintenance records of inspections carried out with details of failures encountered are available, then an objective maintenance model can be used to estimate the delay-time. If however these types of data are not available, then subjective maintenance model must be used. This can be achieved by gathering information from sources such as the maintenance team, operator personnel and management through the use of questionnaires. It has been previously suggested that the number of experts to use is in the region of 3–5 for subjective maintenance model. The consistency of the data is another aspect to consider when gathering data. There could be several sources of data available for a piece of equipment, giving different signals regarding completeness and accuracy of data, which could develop into a time-consuming activity to sort the valid data from the irrelevant data.

Objective Data Analysis: Objective maintenance model requires maintenance data as well as failure and inspection data in order to estimate the values of the parameters that will indicate the arrival rate of a defect l and the delay-time distribution.

Subjective Data Analysis: It has been documented that the delay-time concept as part of subjective data analysis to establish maintenance model is not as straightforward to understand by engineers and operators as first imagined during the study of equipment at a company. Therefore care needs to be taken when developing questionnaires or interrogating inspection data. To help avoid confusion when trying to implement a maintenance model to a manufacturing environment, the term ‘how long ago’ (HLA) and ‘how much longer’ (HML) can be used. The term HLA is a means of establishing from an engineer or a technician how long ago the fault could have been detected. The problem with asking for an estimate for HLA is that possible blame could be leveled at the individual for not identifying the hidden fault at an earlier inspection; therefore, care needs to be taken and trust gained when establishing HLA and HML figures. The delay-time, h can be calculated by adding the HLA and HML together.

Advantages and Disadvantages: There are several advantages and disadvantages for using the subjective maintenance model method for estimating a delay time for a plant or equipment establish maintenance model. The main advantage with subjective maintenance model is that limited failure data are required in order to establish a delay-time estimate, one simply relies on the expertise of the personnel involved with the running of the equipment; moreover, if the majority of maintenance and inspection data existing is unusable, then a means of establishing figures for the required parameters needs to be established even for objective maintenance model [6, 7]. There are however some disadvantages with this method, one disadvantage being that if a lack of faults or failures of the equipment in question is infrequent, then it may take some time to gather enough data for subjective maintenance model to be viable. A second disadvantage is that it can be time consuming. The time to compile and issue the questionnaire to ensure that all staff involved in the process has an understanding of the delay time concept. Understanding the delay-time concept has previously proved to be a tough challenge; therefore, the content of the questionnaire is of vital importance in order to avoid lengthy sessions with relevant experts explaining the questionnaire or gathering inaccurate data. In addition to establishing HLA and HML figures, there are other questions that need to be addressed, namely:

- How many failures do you experience each working day/week/month?
- What is the average downtime for each failure?
- How many faults have been identified at each inspection?
- Please give a brief description of the failure and fault.
- Is the failure or fault preventable?
- If the failure or fault is preventable, briefly describe how.

Case Study: The case study is conducted at ICYM Hostel Building. The analysis is conducted by snapshoot model (Basari, ASH, 2009) The type of analysis includes: -

- Major fault analysis
- Downtime analysis
- Cost analysis

Table 3.1: Number of Faults by Cause of Faults and their Percentages for the Period from January 2012 to June 2012

		CAUSES OF FAULTS								TOTAL FAULT	PERCENT
		Jammed	Broken	Leak	Age	Poor design	Burn	clogged	Other		
TOTAL FAULT		24	126	55	0	23	0	13	5	8	100%
COMPOMENT NAME/AREA OF FAULT	Door	16	102			2				120	48.8
	Water pipe			3		1		5	2	11	4.5
	Sliding door	4		11						15	6.1
	Toilet		15	7		7		8	3	40	16.3
	Ceiling		4	8		6				18	7.3
	Window	2	1	19		1				23	9.3
	Sink		3	7		6				16	6.5
	Table	2	1							3	1.2
PERCENT		9.8	51.2	22.4	o	9.3	0	5.3	2	246	100%

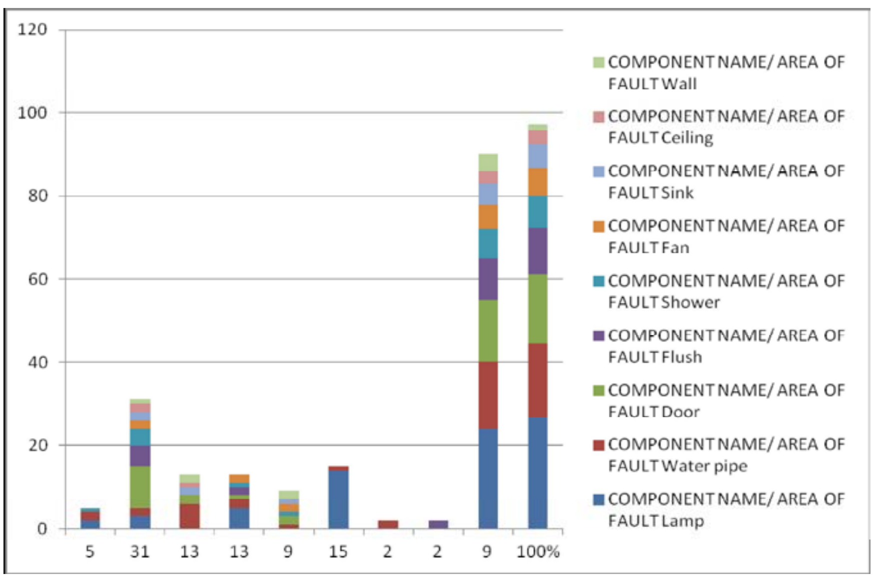

Fig. 3.1: Number of Faults by Area and Cause of Faults for the Period from January 2012 to June 2012

Major Fault Analysis: Major fault analysis is one of the main components of ICYM building analysis the critically of the components of the building can be assessed by looking at the frequency of the type of the faults occurred within the component. Details of the result could be seen in Table 3.1. The cause of fault analysis is really necessary and important in assessing the performance of the maintenance procedure and directions to which is needed to be completed. For example if the cause of fault is due to operator practice then the need of proper training and replace new component is likely reducing the number of faults or breakdowns.

Figure 3.1 shows the total number of faults and detected faults. Details of the result could be seen in this figure and the result, Two worst components which are counted about 48.8% and 65.1% of the faults are Door and Lamp from other component. The major cause of faults that highly affected the maintenance in term of cost is broken for the both component.

Downtime Analysis: The term downtime means the time that an item of equipment is out of service, as a result of equipment failure. The downtime analysis

Table 3.2: Estimated Total Downtime by Area and their Percentages for the Period from January 2012 to June 2012

		CAUSES OF DOWN TIME								TOTAL FAULT	PERCE
		Jammed	Broken	Leak	Age	Poor design	Burn	clogged	Other		
TOTAL FAULT		600	2 400	336	0	312	0	408	0	8	100%
COMPONENT NAME/ AREA OF FAULT	Door	336	1 800			120				2 256	55.6
	Water pipe	192	72	144				24		432	10.7
	Sliding doc	72	24							96	2.4
	Toilet		336	48		120		336		840	20.7
	Ceiling		72	24		48				144	3.5
	Window		24	72						96	2.4
	Sink		72	48		24		48		192	4.7
	Table										
PERCENT		14.8	59.2	8.3	0	7.7	0	10	0	4 056	100%

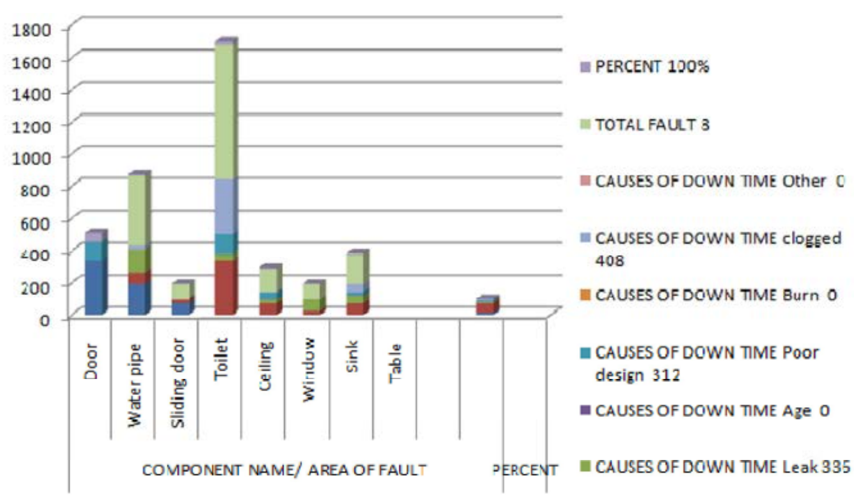

Fig. 3.2: Total Downtime by Area and their Percentages for the Period from January 2012 to June 2012

aims to evaluate the performance of the equipment in term of its availability [8]. In this study the downtime is taken to be equal to the summation of the following times:

- The diagnosis time
- The repair time
- The waiting time for the technicians if there are no technicians at the time of the equipment failure
- The waiting time for the materials if there are no spare parts at the repair time.

Table 3.2 shows the estimated downtime by area and their percentages from January 2012 to June 2012.

Figure 3.2 depicts the estimated downtime by area and cause of faults. Table 3.2 shows the estimated downtime by area and their percentages. From the result, three worst components according to their cause of faults and associated downtime are Wall and Shower. The following observations can be concluded:

Total Cost by Area: The aim of this analysis is to assess the severity of the faults that have occurred in term of downtime and the cost incurred. In this study the cost is taken to be equal to the cost of the technicians or contractors who carried out the diagnosis and repair of the building plus the cost of the materials if spare parts are used and plus the production lost cost due to the disruption of the work. Table 3.3 shows the total estimated cost by area and cause of faults.

Table 3.3: Estimated Total Cost by Area and their Percentages for the Period from January 2012 to June 2012

		CAUSES OF FAULTS								TOTAL FAULT	PERCENT
		Jammed	Broken	Leak	Age	Poor design	Burn	clogged	Other		
	TOTAL FAULT	RM125	RM13 171	RM218	0	RM1 575	0	RM90	0	8	100%
COMPONENT NAME/ AREA OF FAULT	Door	RM70	RM10 125			RM675				RM10 870	71.62
	Water pipe	RM40	RM63	RM126				RM5		RM234	1.54
	Sliding door	RM13	RM133							RM170	1.12
	Toilet		RM2 548	RM42		RM800		RM70		RM3 460	22.79
	Ceiling		RM30	RM10		RM20				RM60	0.4
	Window		RM10	RM30						RM40	0.26
	Sink		RM240	RM10		RM80		RM15		RM345	2.27
	Table										
	PERCENT	0.82	86.77	1.44	0	10.38	0	0.59	0	15 179	100%

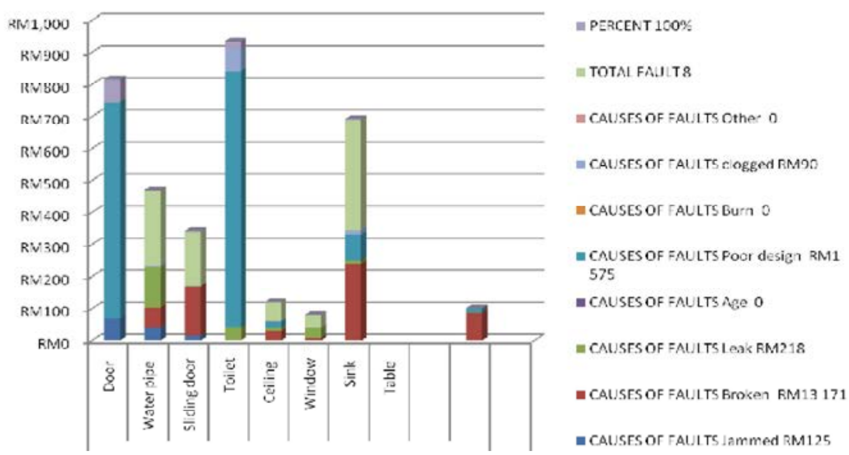

Fig. 3.3: Estimated Total Cost by Area and Cause of Faults for the Period from January 2012 to June 2012

Table 3.3 show the total estimated cost by area and cause of faults. From the result, two worst components according to their cause of faults and associated cost are Door and Fan. The major cause of faults that highly affected the maintenance in term of cost is broken. For Door, the decreasing rate are from RM 13 770 to RM 10 125. As for Fan, the decreasing rate are from RM 1 755 to RM 675.

CONCLUSION AND DISCUSSION

Building Maintenance management for ICYM consists of managing, planning and also controlling the building maintenance. In spite of that there are four supporting factors that need to be considered in making ICYM building maintenance management more effective and efficient when it is executed.

- The Organization structure and general responsibilities of maintenance management.
- The maintenance policies and standard for maintenance.
- The maintenance management planning and scheduling.
- The maintenance management for budgeting and cost controlling [9].

Therefore, there is a deficiency in the ways in which building's maintenance procedures are being managed. Various attempts have been made to improve the performance of buildings through maintenance. While such schedule procedures offer the potential to improve the performance of maintenance management systems, the systems have, however, been reactive, hypothetical and conditionally based. It is these substantial weaknesses in the proposed schedule procedures that have created the fundamental problems with the existing and proposed building maintenance management schedule procedure, causing their inability to improve the existing systems. Maintenance cannot be circumvented, but what is possible is that expenditure on building maintenance can be optimized through a proactive maintenance management system based on the concept of value [10, 11].

Users measure the performance of their building in terms of various criteria that are consistent with their value systems. Maintenance management procedures must be based on the user's value systems. A significant impetus of value-based maintenance management is the progressive realization that maintenance must be viewed from engineering, scientific, technological, political and commercial perspectives [10, 12].

The proposed research to ICYM maintenance management is focusing on the field inspection and condition assessment for educational buildings [13]. ICYM can develop an approach that uses the available maintenance data and resources to predict the condition of components and prioritize them for inspection purposes which identify and investigate the defects, symptoms and interrelationships among top building components [14-16].

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REFERENCES

1. Olanrewaju, A., 2010. Case for alternative approach to building maintenance management of public universities. Journal of Building Appraisal., 5: 201-212.
2. Yuseni Wahab, Abd. Samad Hasan Basari and Burairah Hussin, 2013. Building Maintenance Management: Preliminary Finding of A Case Study in KUIM National Conference Case study in Sabah, 20-22 June 2013.
3. Basari, A.S.H., 2009. Maintenance Modeling Tools with special to Incomplete Data, Phd Thesis, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia.
4. Jones, K. and M. Sharp, 2007. A new performance based process model for built asset maintenance', Facilities, 25(13/14): 525-535.
5. Construction Industry Development Board, 2003. Malaysia (CIDB) Directory 3rd edition, Builder's Infornet (M) Sdn Bhd, Selangor.
6. Jones, B., I. Jenkinson and J. Wang, 2009. Methodology of using delay time analysis for a manufacturing industry. Reliability Engineering System Safe, 94: 111-24.
7. Wang, W., *et al.,* 2010. A multi-component and multi-failure mode inspection model based on the delay time concept. Reliability Eng System Safety, doi:10.1016/j.ress.2010.04.004.
8. Wang, W., 2008. Delay time modeling. In: Murthy DNP, Kobbacy AKS, editors. Complex system maintenance handbook. Amsterdam: Springer; pp: 345-70.
9. Yaacob, S., 2006. Maintenance Management System Through Strategic Planning For Public School In Malaysia, Master Thesis UTM.
10. Ahmad, R.B.H., 2006. Maintenance Management and Services (Case Study: PERKESO, Buildings in Peninsular of Malaysia), Unpublished Master's Thesis, University Technology Malaysia.
11. Ahmad, R., A. Nur Azfahani and I. Nur Haniza, 2006. The effects of design on the maintenance of public housing buildings in Malaysia-part one, Journal of Building Engineers, pp:30-33.
12. Nicola, R.P. and R. Dekker, 2008. Optimal maintenance of multi-component systems: a review. In: D.N.P. Murthy and A.K.S. Kobbacy, editors. Complex system maintenance handbook. Amsterdam: Springer.
13. Christer, A.H. and W.M. Waller, 1984b. Reducing Production Downtime Using Delay Time Analysis. Journal of the Operational Research Society, 35: 499-512.

14. Sibghatullah Nasir, 2013. Microfinance in India: Contemporary Issues and Challenges, Middle-East Journal of Scientific Research, 15(2): 191-199.
15. Mueen Uddin, Asadullah Shah, Raed Alsaqour and Jamshed Memon, 2013. Measuring Efficiency of Tier Level Data Centers to Implement Green Energy Efficient Data Centers, Middle-East Journal of Scientific Research, 15(2): 200-207.
16. Hossein Berenjeian Tabrizi, Ali Abbasi and Hajar Jahadian Sarvestani, 2013. Comparing the Static and Dynamic Balances and Their Relationship with the Anthropometrical Characteristics in the Athletes of Selected Sports, Middle-East Journal of Scientific Research, 15(2): 216-221.